



GEOCAM

Studying a Changing Earth From a Generation Long View Point

(Proposal for a HitchHiker Experiment for the International Space Station)

James H. Nicholson, CAN DO Project Principal Investigator - Medical University of South Carolina

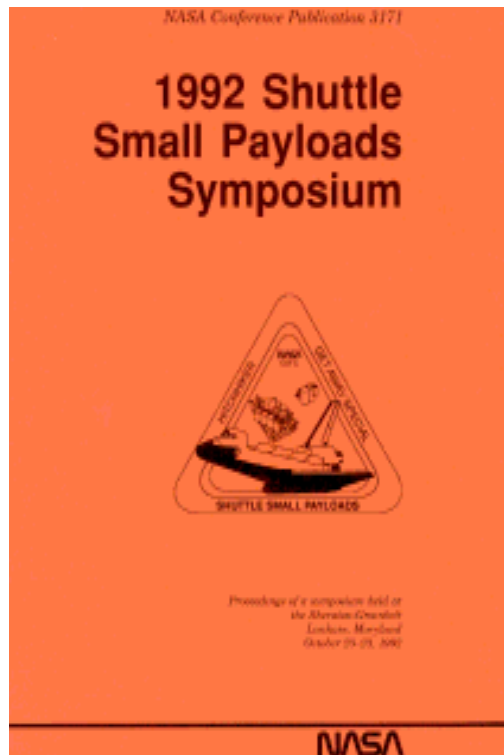
Thomas J. O'Brien, CAN DO Project Chief Engineer - Medical University of South Carolina

Carol A. Tempel, CAN DO Project Coordinator - Charleston County School District

Kathy Rackley, EarthKAM Lead Teacher - Mason Preparatory School

Eve Katuna, EarthKAM Lead Teacher - Drayton Hall Middle School

In 1992



EARTH OBSERVATION PHOTOGRAPHY *LOOKING BACK 20 YEARS AFTER SKYLAB*

GAS #324 CHARLESTON COUNTY SCHOOL DISTRICT CAN DO PROJECT

James H. Nicholson
Thomas J. O'Brien
Mitchell Colgan
Ruth Ashcraft-Truluck
James R. Frysinger
Carol A. Tempel

Principal Investigator
Chief Engineer
Geology Science Advisor
Steering Committee
Orbital Physics
Coordinator

Medical University of South Carolina
Medical University of South Carolina
College of Charleston
Wando High School
Academic Magnet High School
Charleston County School District

ABSTRACT

The Charleston County School District CAN DO project (GAS #324) to photograph the 1986 apparition of Comet Halley. Postponed by disaster of that year, the project had to select new goals. Wishing to design, it was decided to turn the cameras towards the home planet in disciplines of earth science appear in curricula at many different grade levels. High quality photographs of the Earth would have tremendous educational value. A committee of trained classroom teachers, backed by a volunteer team of academic advisors has developed a program for earth science based from low earth orbit.

In selecting targeting objectives, immediate note was made of the fact that (20 years) has passed since the United States' ambitious SKYLAB program. A critical part of those missions was the acquisition of earth photographic data. This objective was systematically furthered through three separate crew visits to the Space Station in 1973-74. Not merely photographing the Earth below, the purpose of the Earth Resource Experiment was to determine what kind, and how much, photographic data could be obtained. This by intensive training before lift-off, real-time scientific mission planning support ... qualities which have corollaries to what is here proposed.

The collection of 35,000 photos produced by EREP, in six registers, is still the most complete photographic coverage of the planet undertaken. The body of data remains under-utilized. GAS #324 intends to operate as a considerable national asset, and to contribute an added tier of relevant inventory of planetary data. Improvements in modern film technology, camera system to match closely the larger SKYLAB film format in both film and optics. The photography acquired by CAN DO should allow a direct examination of the changes that have occurred to the Globe in the last twenty years.

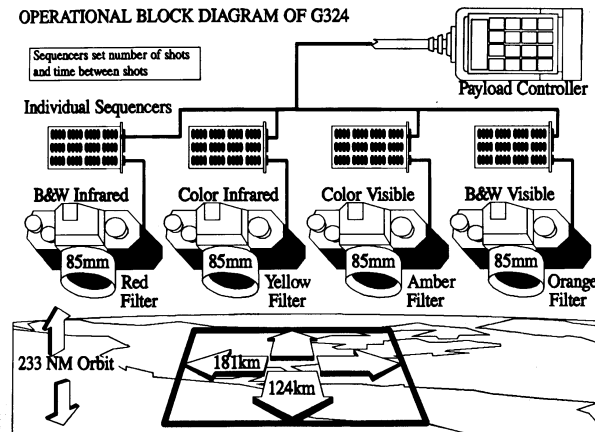


FIGURE 4 CAMERA WITH 250 EXPOSURE BACK

53

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1992 GeoCam Goals

- ✓ To take high resolution images of the earth in both visible light and infrared
- ✓ To control the payload with the first student operated POCC
- ✓ To design a system to closely match the Skylab S190a camera system
- ✓ To make direct comparisons between GeoCam and Skylab images to measure 20 years of change

Skylab (1973-1974)



- ☐ First systematic photo-survey of the Earth
- ☐ Pioneered multi-spectral photography
- ☐ Test bed for 1st Landsat satellite
- ☐ Provides the earliest baseline to measure environmental change

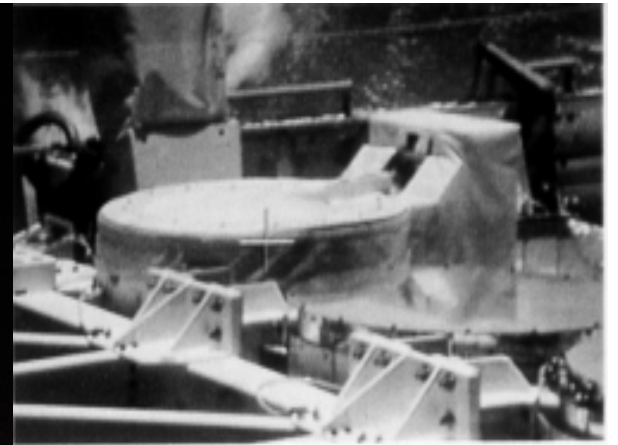
S190a Camera System

Columbia SC

- ☐ Part of EREP (Earth Resource Experiment Package)
- ☐ 6 highly modified Hasselblad cameras
- ☐ Multispectral system
 - Green
 - Red
 - 2 –infrared
 - Infrared color
 - Natural color
- ☐ 36,000 images



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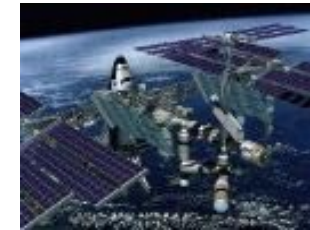


Results from GeoCam



- ✓ To take high resolution images of the earth in visible light and infrared
- ✓ To control the payload with the first student operated POCC
- ✓ To design a system to match the Skylab s190a camera system parameters
- ✗ To make comparison between GeoCam and Skylab images to measure 20 years of change

Mission Parameters



	Skylab	STS-57	ISS
Altitude	268 mile	252 mile	250 mile
Inclination	50°	28.5°	51.6
duration	171 days (manned)	10 days	indefinite

To Match Images

San Diego



Skylab



STS-34



STS-39



STS-60



☐ By design

- ✓ Altitude/focal length
- ✓ Spectrum

☐ By time/luck

- ✓ Orbital Track
- ✓ Sun angle
- ✓ Weather



The Ideal Platform



Earth Imaging Programs



	GeoCam	EarthKAM	GeoCam II
Image Type	Film	Digital	Digital
Resolution	Very High*	2K x 3K (composite)	2K x 2K (per channel)
Bands	RGB + 1IR	RGB	R+G+B+2IR
Control	Ground	Ground	Ground
Images	Stored	Downlink	Downlink

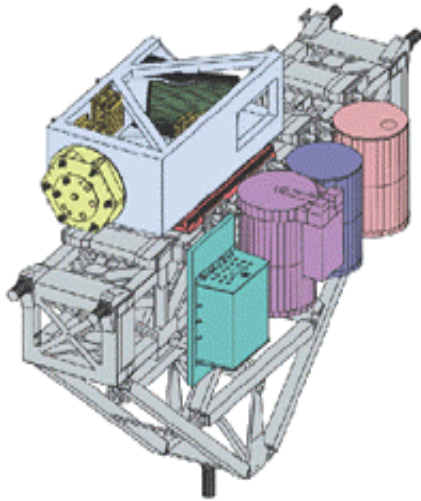
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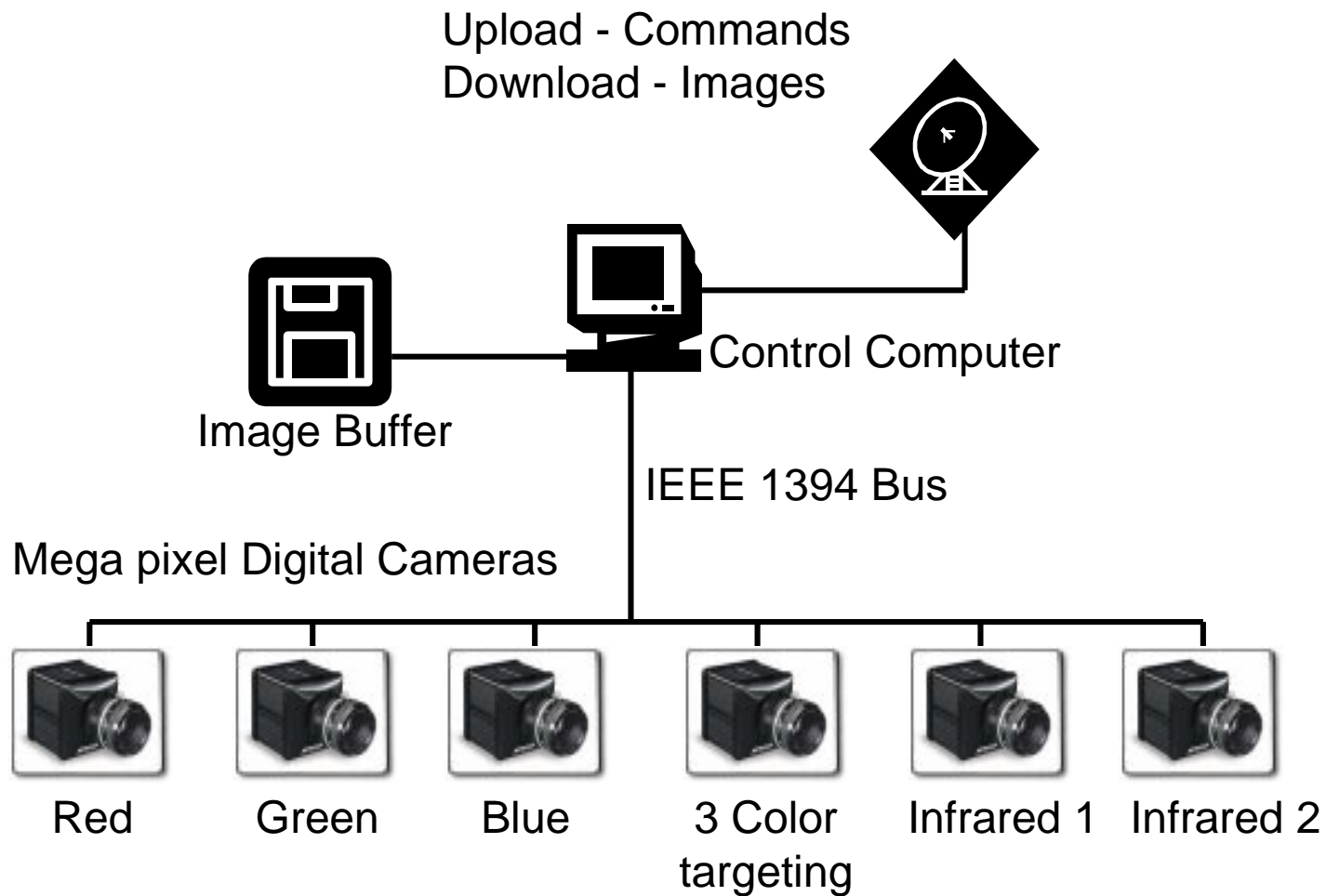


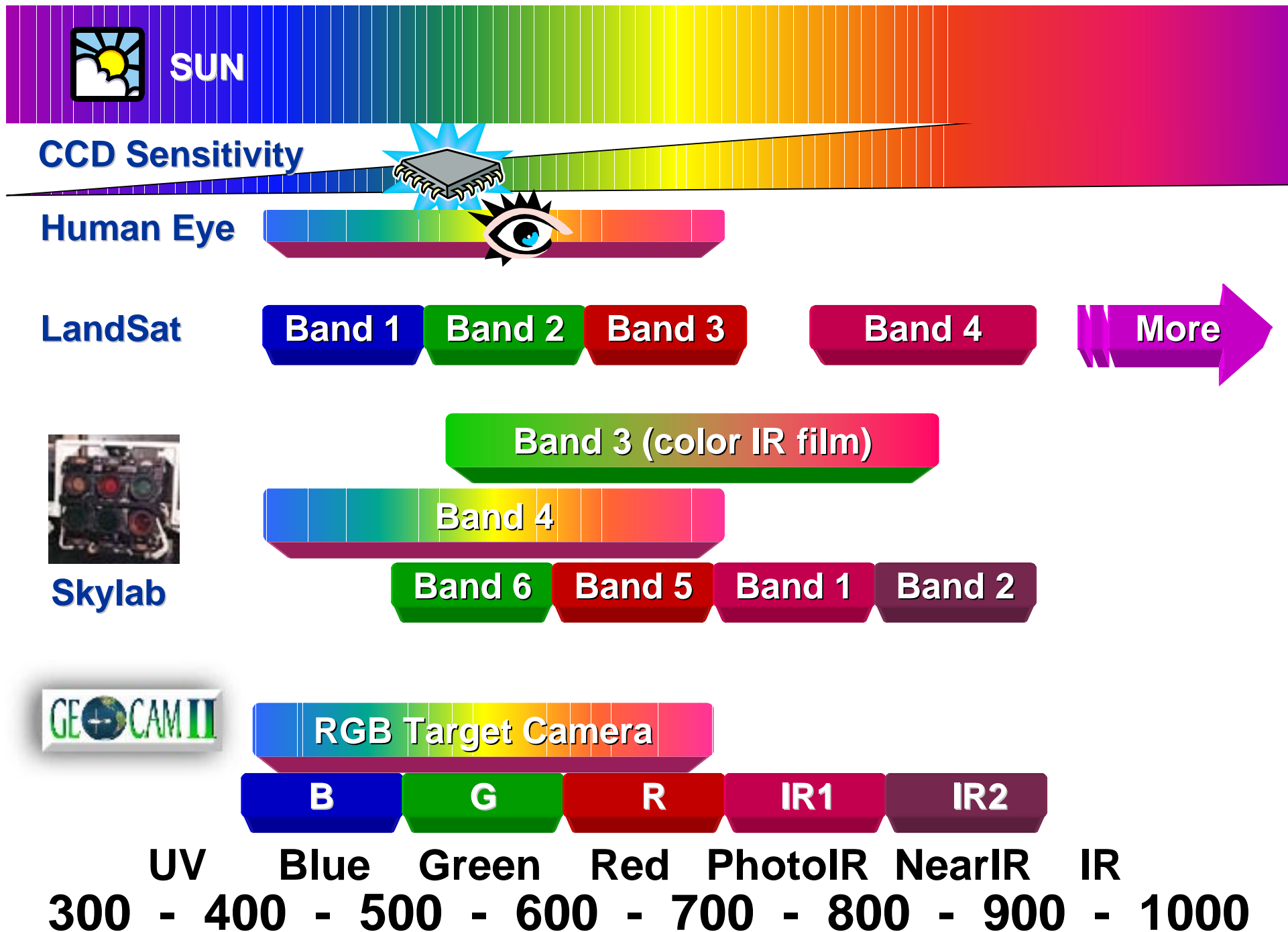
Design



- ❑ Standard Hitchhiker/GAS hardware and specifications
- ❑ camera system in HH/GAS five cubic foot canister with MDA (motorized door assembly)
- ❑ Fused silica window(s)
- ❑ Camera control uplinked through the Hitchhiker control uplink, (RS-422 serial format (1200 baud) channel)
- ❑ Images downloaded through either the ISS MRDL (Medium Rate Data Link) or the HRDL (High Rate Data Link)

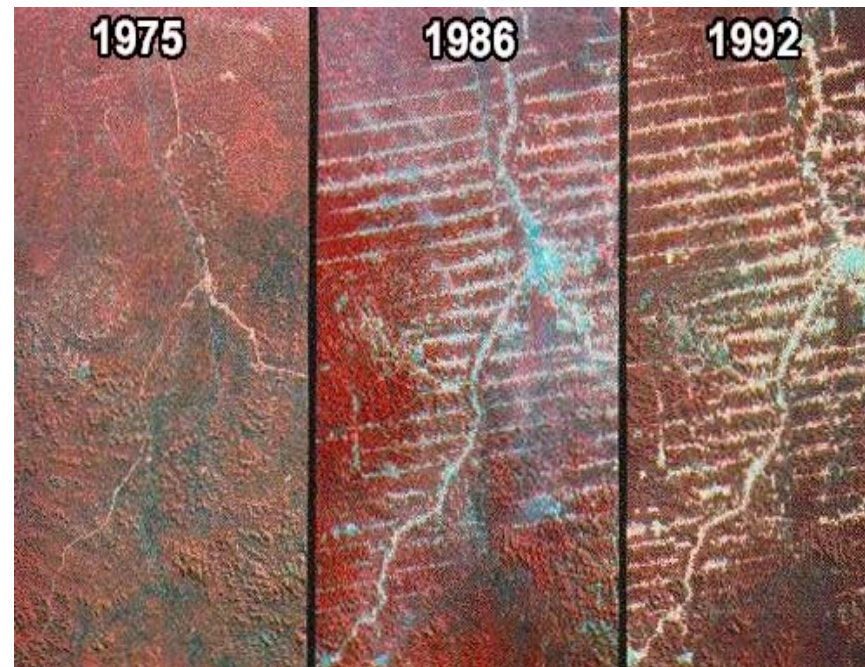
Control System



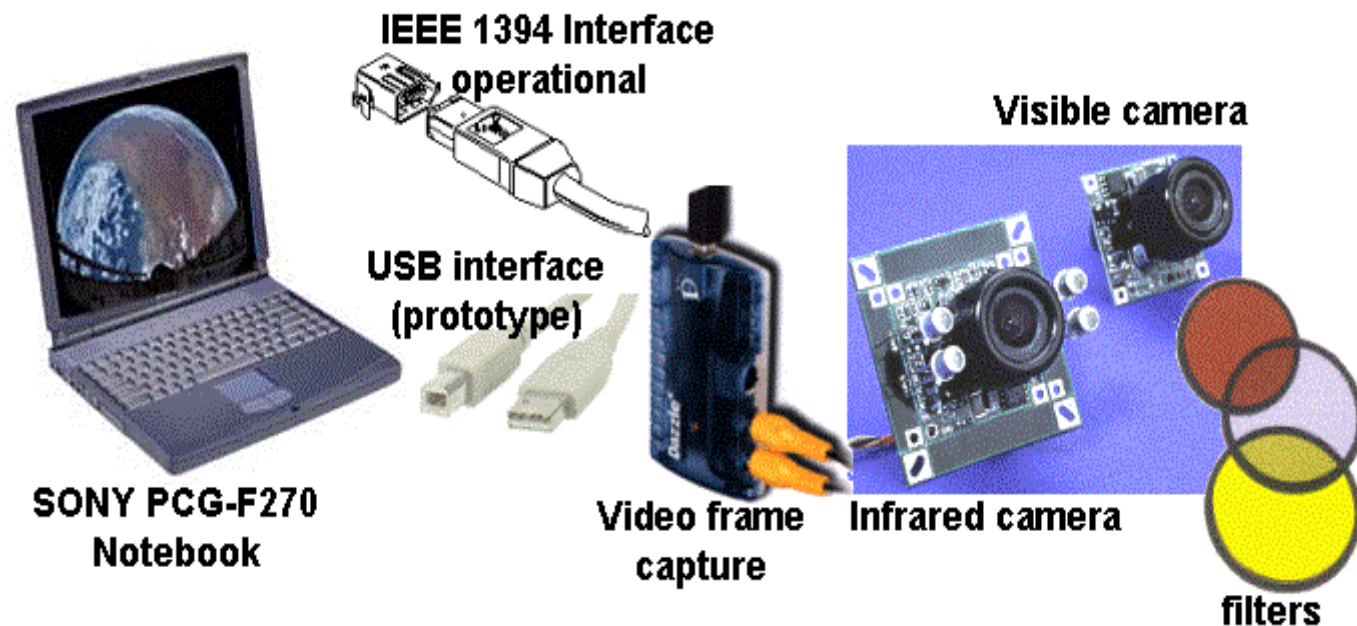


The value of infrared imaging

- ❑ A primary remote sensing tool
- ❑ Least affected by atmosphere
- ❑ Used to evaluate the total biomass and health of plant coverage
- ❑ Especially useful to quantify change over time
- ❑ Example – Deforestation in the Amazon



Prototype



- ☐ Proof of concept testing
- ☐ Demonstration unit
- ☐ Training Tool

Possible Flight Testing

GAS
carrier system



Hitchhiker Jr
carrier system



Hitchhiker
carrier system



Resolution (per band)	640x480 (5 band +RGB)	1024x1024 (5 band +RGB)	2048x2048 (5 band +RGB)
power	Internal battery	100W supplied	1500W supplied
control	automatic	Crew/auto	ground
images	stored	stored	downlink

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Building the Team

Even more than the original GeoCam in 1992, GeoCam II will require participation by:

- ☐ Educators
- ☐ Institutions
 - National Geographic
 - National Science Teachers Association
- ☐ Industry
 - Chroma Filters
 - Eastman Kodak
- ☐ NASA Centers





From Control Room to Classroom

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GE+CAM II

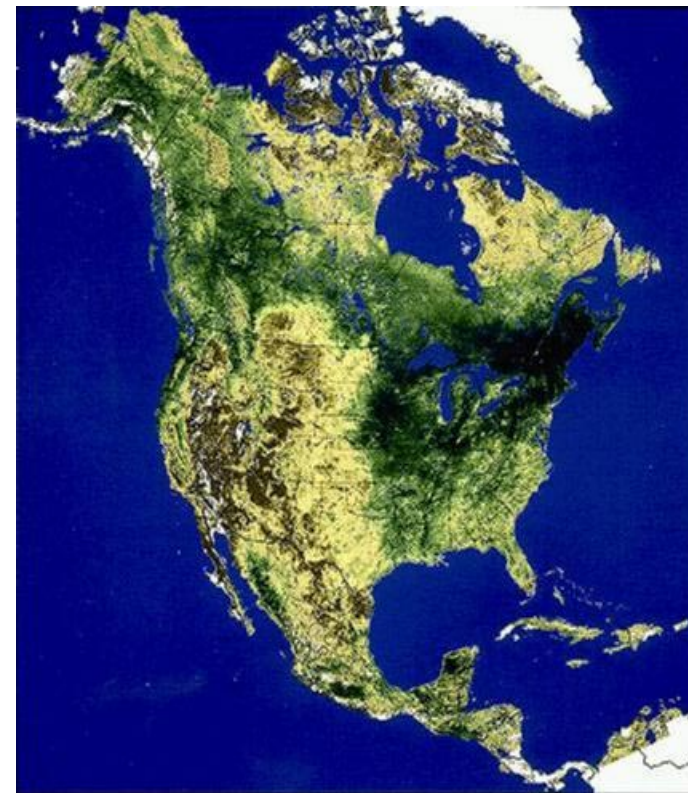
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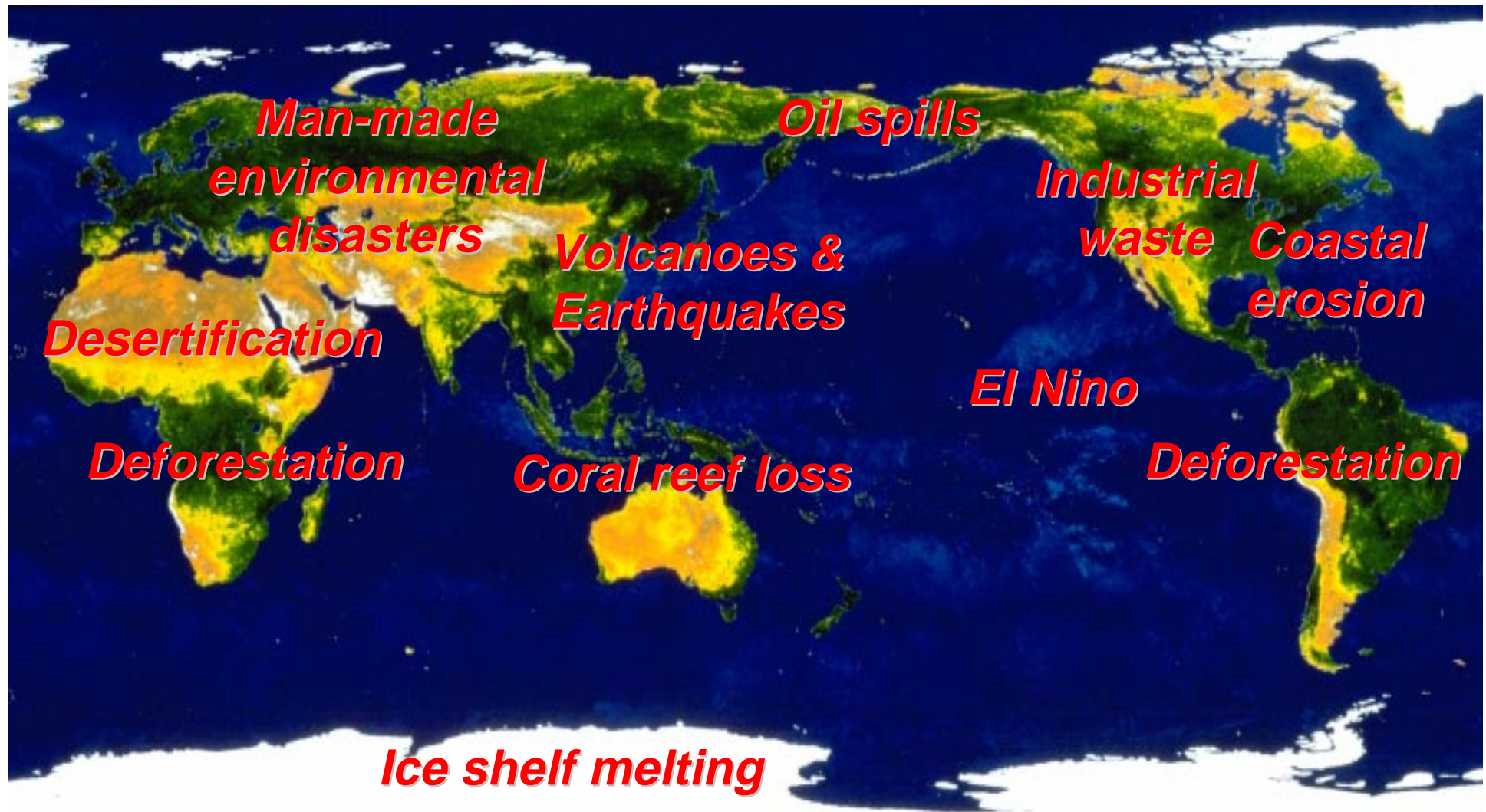
The View from Space

Human actions that change the reflectance or color of the Earth's surface can be recorded with space photography

- ☐ **DEFORESTATION**
- ☐ **URBANIZATION**
- ☐ **SEDIMENT LOADS**
- ☐ **DESERTIFICATION**
- ☐ **COASTAL EROSION**
- ☐ **LAKE LEVELS**
- ☐ **WETLANDS**

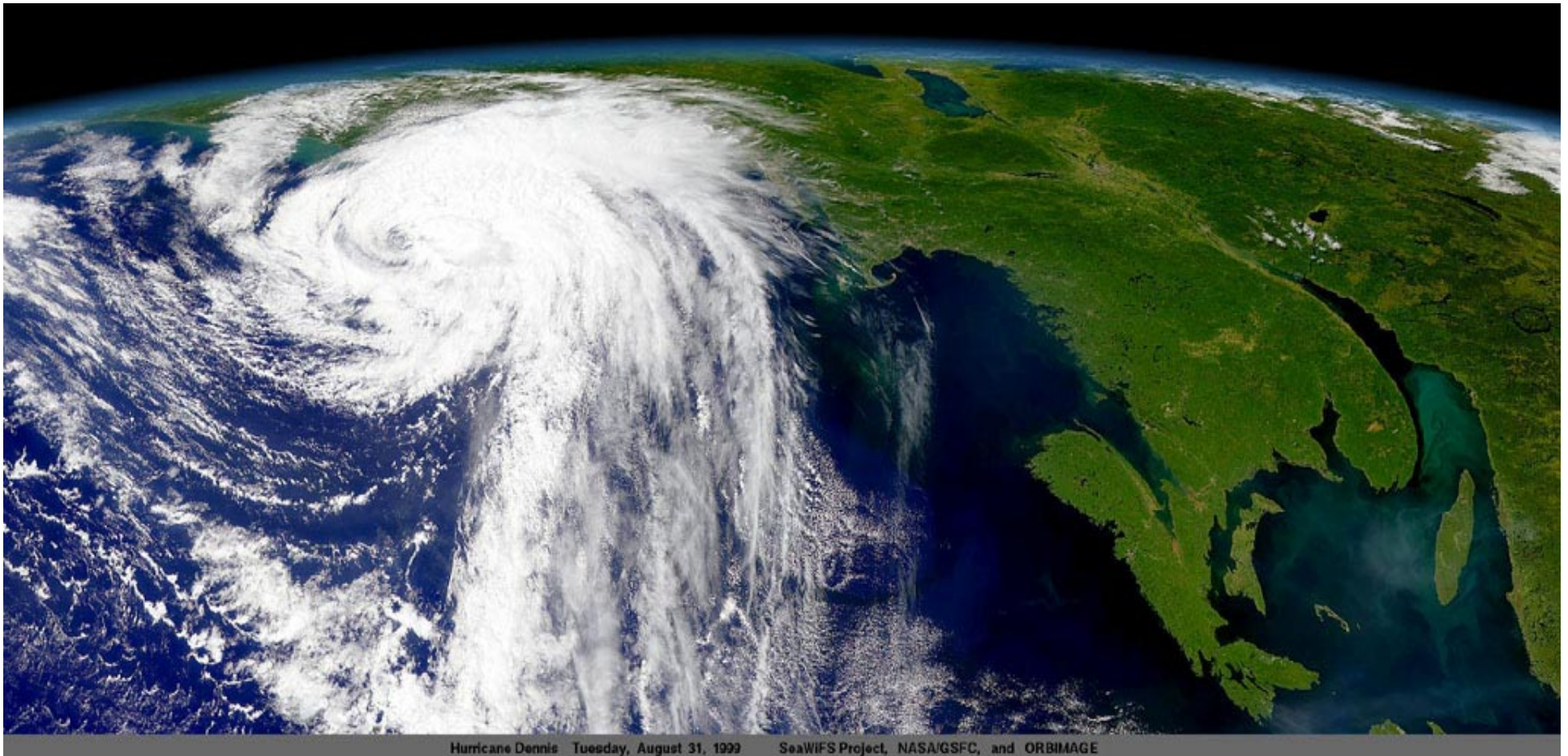


A quarter century of dramatic changes



Other applications - Weather

Hurricane Dennis - 1999



Hurricane Dennis Tuesday, August 31, 1999 SeaWiFS Project, NASA/GSFC, and ORBIMAGE

GeoCam II and Education

Provides stimulating hands-on experiences for students and teachers to interpret global environmental changes



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Student Goals

- ✓ Engage in serious earth science research
- ✓ Utilize new technologies in the classroom
- ✓ Investigate environmental change over time using matched images
- ✓ Collaborate with leading ISS scientists
- ✓ Explore earth system science careers



Teacher Goals

- ✓ Partner with students on research projects
- ✓ Learn new technology skills to use in the classroom
- ✓ Apply remote sensing to the teaching of earth science
- ✓ Advance their own professional growth



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On the way to the Moon,
Man discovered the Earth

